ASSESSMENT ON THE DEVELOPMENT AND COASTAL EROSION ALONG THE MIDDLE COASTLINE OF TERENGGANU

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by

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Dissertation submitted in partial fulfillment of
the requirements for the
Bachelor of Engineering (Hons)
(Civil Engineering)

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CERTIFICATION OF APPROVAL

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A project dissertation submitted to the
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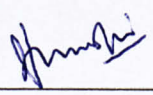
Approved by,



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UNIVERSITI TEKNOLOGI PETRONAS
TRONOH, PERAK
July 2009

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

NOOR HIDZIR BIN ABDUL WAHAB

ABSTRACT

Realizing the importance of knowing and taking care of coastal area, the coastal erosion becomes the major topic since 1980s because it gives major impact to population who live nearby the Malaysian coastline, economy, socio-economy, habitat, and flora and fauna.

The study of coastal erosion is important because if the particular area encounter severe coastal erosion problem, thus the immediate action should be recommended to the authority by proposing appropriate solution.

Due to that, author has interested to do research on this process which entitled as "Assessment on the Development and Coastal Erosion along the Middle Coastline of Terengganu". More specifically, the area covered is from Kampung Merabang Panjang, Batu Rakit until Kampung Jambu Bongkok, Marang.

This report describes the coastal erosion problems that motivate this research. It elaborates the background of the study and the methodology in conducting the investigation. Eventually the report presents the findings and results achieved.

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- Officers from Department of Irrigation and Drainage, Ipoh, Perak
- Technicians from Civil Department, UTP

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CHAPTER 1
INTRODUCTION

1.1 BACKGROUND OF STUDY

Realizing the increasing incidences of coastal erosion which threatens coastal population and leading to loss of properties along the coastlines, the Government of Malaysia carried out the National Coastal Erosion Study from November 1984 to January 1986. The study reveals that out of the country's coastline of 4809 km, about 29% or 1380 km was facing erosion. In order to cope with this problem, the Government set up the Coastal Engineering Centre in the Department of Irrigation and Drainage (DID) in 1987 to implement coastal erosion control program throughout the country.

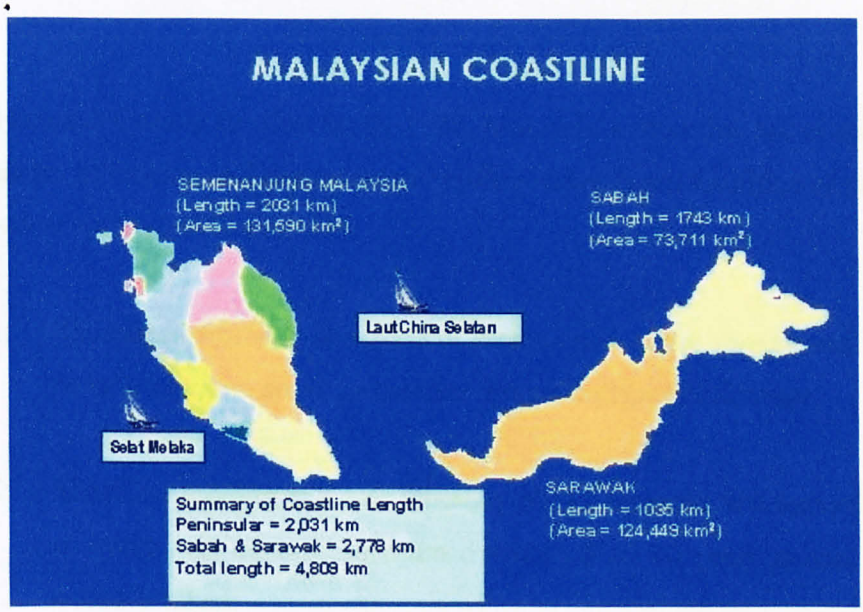

Figure 1.1: Malaysian Coastline, *source: http://www.water.gov.my/*

The Malaysian coastline varies from scenic bays flanked by rocky headlands to shallow mud flats lined with mangrove forests. On the east coast of Peninsular Malaysia, the high sediment yield from river discharges and harsher wave environment create the setting for a coastline of hook-shaped sandy bays. Whilst on the west coast, the mild wave climate of the Straits of Malacca make for wide mud shores and coastal forests rich in biodiversity. Similar forms characterize the beaches of Sarawak and Sabah although certain sandy areas are very flat. Shore materials include a mix of sand, silts, and even shells with some patches of gravels and the occasional rock outcrops.

There are more than 150 river mouths in Malaysia country-region and many of them face siltation problem, which reduces the water depth for fishing traffic access and has negative impact on the fishing industry development. The Government has carried out the National River Mouth Study in 1994 and the study results indicate that 35 river mouths faced critical siltation. The master plan developed recommends that improvement work be carried out in 10 years involving a total cost of RM 330 millions. Based on the master plan, a river mouth improvement program was approved under the Seventh Malaysia Plan for carrying out dredging and construction of improvement structures.

Based on National Coastal Erosion Study 1986, Malaysia's shoreline are classified into three categories of erosion and the threat to existing shore-based facilities of substantial economic value and defined as follows:

Category 1: Shorelines currently in a state of erosion and where shore-based facilities or infrastructure are in immediate danger collapse or damage.

Category 2: Shoreline eroding at a rate whereby public property and agriculture land of value will become threatened within 5 to 10 years unless remedial action is taken;

Category 3: Undeveloped shoreline experiencing erosion but with no or minor consequent economic loss if left unchecked.

Figure 1.2: Coastal Erosion Category 1, *source:* http://www.water.gov.my/

Figure 1.3: Coastal Erosion Category 2, *source:* http://www.water.gov.my/

Figure 1.4: Coastal Erosion Category 3, *source: http://www.water.gov.my/*

The causes of erosion are both natural and man-induced. A beach in its natural state experiences cycles and deposition but over a long period of time, a beach is considered stable if its mean position remains unchanged. In most cases, the root causes of erosion have been man-made activities which result in direct or residual impact to the near shore and the beach. Among causes of erosion as listed below:

- Causes of erosion – natural
    - Major storms during high tide
- Causes of erosion – man-made
    - Ports/harbour
    - Marinas
    - Ridge,
    - Bridge, etc

State	Length of Coastline	Length of Coastline Having Erosion			Total Length of Coastline	
		Category 1 CRITICAL EROSION	Category 2 SIGNIFICANT EROSION	Category 3 ACCEPTABLE EROSION	Having Erosion	
	(km)	(km)	(km)	(km)	(km)	(%)
State		Length Critically Eroded				
Perlis	20	4.4	3.7	6.4	14.5	72.50%
Kedah	148	31.4	2.2	9.9	43.5	29.40%
Pulau Pinang	152	42.4	19.7	1.1	63.2	41.60%
Perak	230	28.3	18.8	93.1	140.2	61.00%
Selangor	213	63.5	22.3	66.1	151.9	71.30%
N. Sembilan	58	3.9	7.7	12.9	24.5	42.20%
Melaka	73	15.6	15.1	6	36.7	50.30%
Johor	492	28.9	50.3	155.6	234.8	47.70%
Pahang	271	12.4	5.2	107.8	125.4	46.30%
Terengganu	244	20	10	122.4	152.4	62.50%
Kelantan	71	5	9.5	37.6	52.1	73.40%
W.P. Labuan	59	2.5	3	25.1	30.6	51.90%
Sarawak	1,035	17.3	22.3	9.6	49.2	4.80%
Sabah	1,743	12.8	3.5	279.2	295.5	17.00%
TOTAL:	4,809	288.4	193.3	932.8	1,415	29.41%
		6.0%	4.0%	19.4%		

( ) are the numbers of area of erosion Source: Coastal Engineering Division, DID Malaysia, 20

Table 1.1: Length of coastal erosion by categories, *source: http://www.water.gov.my/*

From the table above, Terengganu is among the longest length of eroding coastline in Peninsular Malaysia after Johor and Pahang. By referring to this table, we can compare the recent situation at Terengganu especially at the middle of Terengganu either the coastal is still at the same category or has changes of the category.

1.2 PROBLEM STATEMENT

1.2.1 Problem Identification

There has been no comprehensive study covering the entire Malaysia coastline since the completion of the National Coastal Erosion Study in 1986. Numerous developments have taken place and significant changes have been observed especially along the Terengganu coastline for the past more than 20 years. Thus, a revisit and reassessment such as this research is very timely to update the previous findings and subsequently develop better understanding.

The focus of the study is to assess the development and coastal erosion at middle of Terengganu starting from Kampung Merabang Panjang, Batu Rakit until Kampung Jambu Bongkok, Marang. The assessment is based on the National Coastal Erosion Study and to compare the current coastal erosion with the study either that particular areas still fall on same category or change in category because of the erosion becomes more severe or becomes less erosion.

Apart from that, this study is also to assess the erosion control projects done by authority or developer of coastal. This research will assess the performance of the protection works and to observe the impact to the adjacent coastline, if any. Wherever possible, this assessment may include appraisal on the implemented erosion control, the failure of the design and the failure of the erosion control itself.

At the end, this study will give recommendations what are current or latest actions should be taken from authorities to prevent and control the coastal erosion. Some coastal control projects include revetment, breakwater, concrete blocks, training wall, beach nourishment, mangrove replanting, sediment filled goetextile breakwaters and pressure equalization module.

1.2.2 Significant of the Project

This project, assessing the development and coastal erosion along the Terengganu shoreline is very significant because there is no comprehensive and details study regarding this topic after the National Coastal Erosion Study (NCES) on 1986. This project is on 2009 which is almost 23 years after the study.

Of course, after 23 years there will be changes to the shoreline by nature or by man-made. Other than that, along the shoreline it has development that may affect the shoreline. It is not only the development for tourisms and economy activities but the development of controlling the erosion of the coastal itself.

In the NCES study, it already classified the coastal to the appropriate and suitable category either they lay on category 1 (severe), category 2 (moderately severe) or category 3 (less severe). As time goes by, the coastal category may change to other categories depending on the current situation. Therefore, this project will reassess to update the current coastal and reclassify to correct category.

1.3 OBJECTIVES

The objectives of this project are derived from the problem statement mentioned in this report. The objectives are set to ensure that this project is on track to focus what are the findings and outcomes should be obtained at the end of this project.

The main objective of this project is to study and update the earlier findings from The National Erosion Study with the current erosion at the middle of Terengganu. Apart from that, this project aims:

1. To study and assess the development along the shoreline from Kuala Terengganu to Marang.

2. To study and assess the coastal erosion along the shoreline from Kuala Terengganu to Marang.

3. To study and assess the effect of developments and projects at coastal areas and also the effectiveness of the erosion control projects.

4. To recommend to the authority for further actions in future based on the findings and results obtained at the end of this project.

1.4 SCOPE OF STUDY

To ensure that this project will achieve the objectives that have been set, the scope of study is also set up. By clarifying and identifying the scope of study, this project will be more reliable, feasible, and practical. This study will cover several scopes which are:

1. The study only focuses the shoreline from Kampung Merabang Panjang, Batu Rakit until Kampung Jambu Bongkok, Marang. This limitation is to give ample time to assess and thorough assessment can be done.
2. The assessment only by comparing the current coastal erosion with previous coastal erosion based on National Coastal Erosion Study. By visual observation and photo snaps, the coastal erosion can be compared between current situations with previous situation.
3. The assessment of the impact of the development will be based on the visual observation comparison, sieve analysis experiment which is grading the coastal sand and also the marine sample.

1.5 RELEVANCY OF THE PROJECT

By identifying the objectives set, the project is relevant to be completed in two semesters or approximately one year because the assessment of the project can be done during the site visit. The site visit can be done and arranged during mid-semester break or semester break. In fact, this report will include the findings obtained during the site visit from 24th March 2009 to 25th March 2009 and 5th September 2009 to 7th September 2009.

In two semester or almost one year period of study, there are two mid-semester break and one mid semester break. Thus, the site visit can be made at least three times to get thorough assessment of the coastal shoreline.

In general, all the objectives can be achieved during the site visit except for the last objective which is recommendations. Recommendations can be made after the study of the findings during the site visit.

1.6 FEASIBILITY OF THE PROJECT

Although this project base is at Terengganu, it still can be considered as feasible to conduct and run this project. Terengganu might far from Universiti Teknologi PETRONAS which is located at Perak, but the time can be arranged so that there is time to make several site visits to assess the physical condition of the shoreline at Terengganu.

Besides that, this project also gets help from Jabatan Pengairan dan Saliran Perak (Department of Irrigation and Drainage, Perak) who provides the reports of the National Coastal Erosion Study and Natinal Rivermouth Study as reference to this project.

Since this assessment of the development and the coastal erosion are more focus the physical condition, this project gives better path to succeed as this project does not need special device or equipment to determine and assess both development and coastal erosion.

Only simple devices are needed during the site visit such as portable GPS, measuring tape and compass. This equipment can be easily borrowed from the Civil Engineering Department laboratory.

This project is actually more on interviewing and seeking for information from the local authorities and the villagers nearby who can give extra information for the condition of the coastal area.

CHAPTER 2
LITERATURE REVIEW

2.1 CAUSE OF EROSION

Silvester and Hsu (1997) point out that the main causes of erosion "Alterations in longshore drift can be due to natural or man-induced causes. The former may be related to rivers or the wave climate. The latter are structures built on the coast either to directly impede movement, or do so as a consequence of other goals." (p. 275).

From the statement above, the major causes of erosion can be natural or man-induced causes. The initial effect of erosion is the offshore deepened and therefore the nearshore bed slope will be steepened. Because of this, the beach needs or requires more material to achieve or maintain the previous profile.

The rivers are main element in discharging sediment to the beach or coast. The rivers could supply the materials to be placed at the beach to reach the equilibrium. But, the number of vegetation and the slope of catchment area will affect the water to come to the shore. If the beaches cannot receive the material, so the erosion might happen in short period of time. In fact, if dredging activities happen near the rivers to beaches, it will also spoil the supply of material from the rivers to the coast.

While the man-induced cause can be understood by "As far as man's influence on longshore drift is concerned, his attempts at retaining sand on certain sections of shoreline by way of groins can cause erosion downcoast. This implies that one beach's salvation can be another's destruction." (Silvester and Hsu, 1007, p. 276).

Sometimes the structures built are to protect only at the particular area. While these structures are serving the purpose, protecting from the erosion, it might give impact to the area nearby. Thus, it is actually not solving the erosion problem but transferring the problem to other places.

2.2 COASTAL EROSION CONTROL

"Shore-protection works are aimed at preserving life and the coastal infrastructure located in the backshore against wave attack, storm surge, and erosion that accompanies severe tropical and extratropical storms." (K. Stauble & C. Kraus, 1993, p. 2)

From above statement, the coastal erosion control is important to preserve the environment of the coastal as well as to maintain the coast profile. The coastal erosion control may include the natural development of the coastline, to prevent coastal retreat at certain places, to prevent overall shoreline retreat and last but not least, to strengthen coastal defense at weak places or area along the coastline by constructing the defense work or control work.

2.2.1 Revetment

Coastal erosion coastal control projects also somehow can make the coastal erosion become severe. Revetments are onshore structures with the principal function of protecting the shoreline from erosion. Revetment structures are flexible and typically consist of armor rock or cast concrete blocks. Revetments rest on the surface being protected and depend on it for support. They are relatively light structures and are well suited to locations free of heavy wave attack. Properly designed and constructed revetments are long life structures and require little maintenance.

Almost all concrete armor units revetment rely on their interlocking design for stability. Voids within the revetment permit quick drainage over the surface of the slope and hence reduces wave run-up. However, it has been observed in recent years by the DID that when revetments are built on sandy shorelines, the fronting beach gradually reduces in width.

2.2.2 Beach nourishment

Beach nourishment can be understood as "Beach nourishment, the artificial placement of sand on a sediment-deficient beach, is becoming a preferred method of shore protection along coastlines with a history of erosion" (K. Stauble & C. Kraus, 1993). Another definition is "The process of replenishing a beach. It may be brought about naturally, by longshore transport, or artificially by the deposition by the deposition of dredged materials." (U.S Army, 2001).

Beach nourishment is also known as beach replenishment, beach feeding or beach recharge. Beach nourishment is a soft structure solution used for prevention of shoreline erosion. Material of preferably the same, or larger, grain size and density as the natural beach material is artificially placed on the eroded part of the beach to compensate for the lack of natural supply of beach material. The beach fill might protect not only the beach where it is placed, but also downdrift stretches by providing an updrift point source of sand. Wave energy is absorbed by the added length of beach slope introduced.

Beach nourishment works entails finding a suitable source of material that is compatible with, but not necessarily identical to the material on the beach to be nourished. This method is often the preferred means of protecting a sandy shoreline as it provided the necessary reservoir of material that allows a beach to respond to wave action and achieve equilibrium. The typical interval for renourishing a beach is about 5 years.

2.2.3 Breakwater

Breakwaters are built to reduce wave action in an area in the lee of the structure. Wave action is reduced through a combination of reflection and dissipation of incoming wave energy. When used for harbors, breakwaters are constructed to create sufficiently calm waters for safe mooring and loading operations, handling of ships, and protection of harbor facilities. Breakwaters also built to improve maneuvering conditions at river mouth entrances and to help regulate sedimentation by directing currents and by creating areas with different levels of wave disturbance. Breakwaters can be classified into two main types which are sloping-front and vertical-front structures.

Sloping-front structures are in most cases rubble-mound structures armored with rock or concrete armor units, with or without wave wall super-structures. Vertical-front structures are in most cases constructed of either sandfilled concrete caissons or stacked massive concrete blocks placed on a rubble stone bedding layer. In deep water, concrete caissons are often placed on a high mound of quarry rock for economical reasons.

Figure 2.1: Breakwaters at Sungai Marang rivermouth, Terengganu,

source: http://www.water.gov.my/

2.2.4 Training Wall

Training walls are structures built to direct flow. A typical function of training walls is to improve mooring conditions in an estuary or to direct littoral drift away from an area of potential deposition. Damage to tidal control gate and erosion of beach profile can be stopped or at least mitigated by the construction of training walls.

2.2.5 Groynes

Groynes are built to stabilize a stretch of natural or artificially nourished beach against erosion that is due primarily to a net longshore loss of beach material. Groynes function only when longshore transport is present. Groynes are narrow structures, usually straight and perpendicular to the pre-project shoreline.

The effect of a single groyne is accretion of beach material on the updrift side and erosion on the downdrift side; both effects extend some distance from the structure. Consequently, a groyne system (series of groynes) results in a saw-tooth-shaped shoreline within the groyne field and a differential in beach level on either side of the groynes.

2.1.6 Geotextile

Geotextile tubes or geo-tubes for short and large tube or sausage-shaped (greater than 2.5 m in circumference) geotextiles fabricated from high strength woven geotextile in lengths greater than 6 m. These can be used in both coastal and river environments and they are filled hydraulically with slurry of sand and water.

An apron of geotextile wider than the geo-tube base may be included as part of the design to protect the seaward edge of the geo-tube from the effects of scouring. Scour aprons are typically anchored by a small tube at the water's edge or by sandbags attached to the apron. On the open coast, geo-tubes are laid parallel to shore as a beach or nearshore breakwater with the primary function of limiting the wave height in its lee.

CHAPTER 3
METHODOLOGY

3.1 PROJECT METHODOLOGY

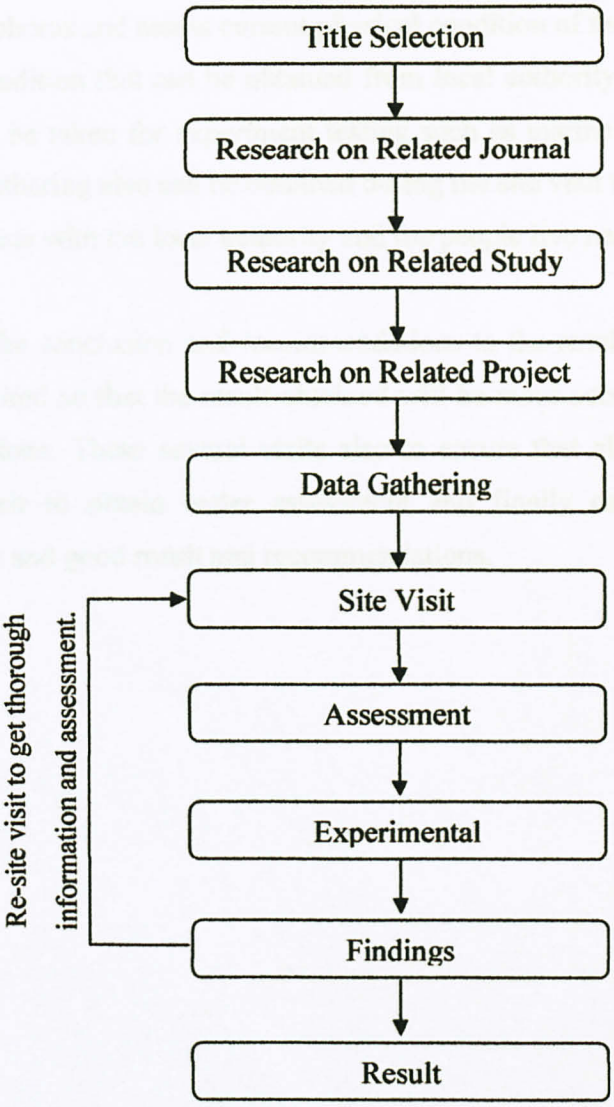

Figure 3.1: Flow Chart of Project Methodology

3.2 PROJECT ACTIVITIES

The research starts with extensive search on journals related to the project title. Besides, data gathering activity is also taken place whereby to get clearer picture about the project by seeking the basis of the project which is previous study which named as National Coastal Erosion Study and National Rivermouth Study.

After obtaining adequate data and information, next activity will be the site visit. Site visit will collect the photos and assess current physical condition of the site and compare with the previous condition that can be obtained from local authority. During site visit, several samples will be taken for experiment testing such as marine water sample and sand sample. Data gathering also can be obtained during the site visit when the interview sessions are taken place with the local authority and the people live nearby the site.

Before it comes to the conclusion and recommendations to the result obtained, re-visit will be done as required so that the result obtained will be more accurate and thorough assessment can be done. These several visits also to ensure that all the place can be covered for site visit to obtain better assessment and finally can come out with appropriate, accurate and good result and recommendations.

3.3 GANTT CHART

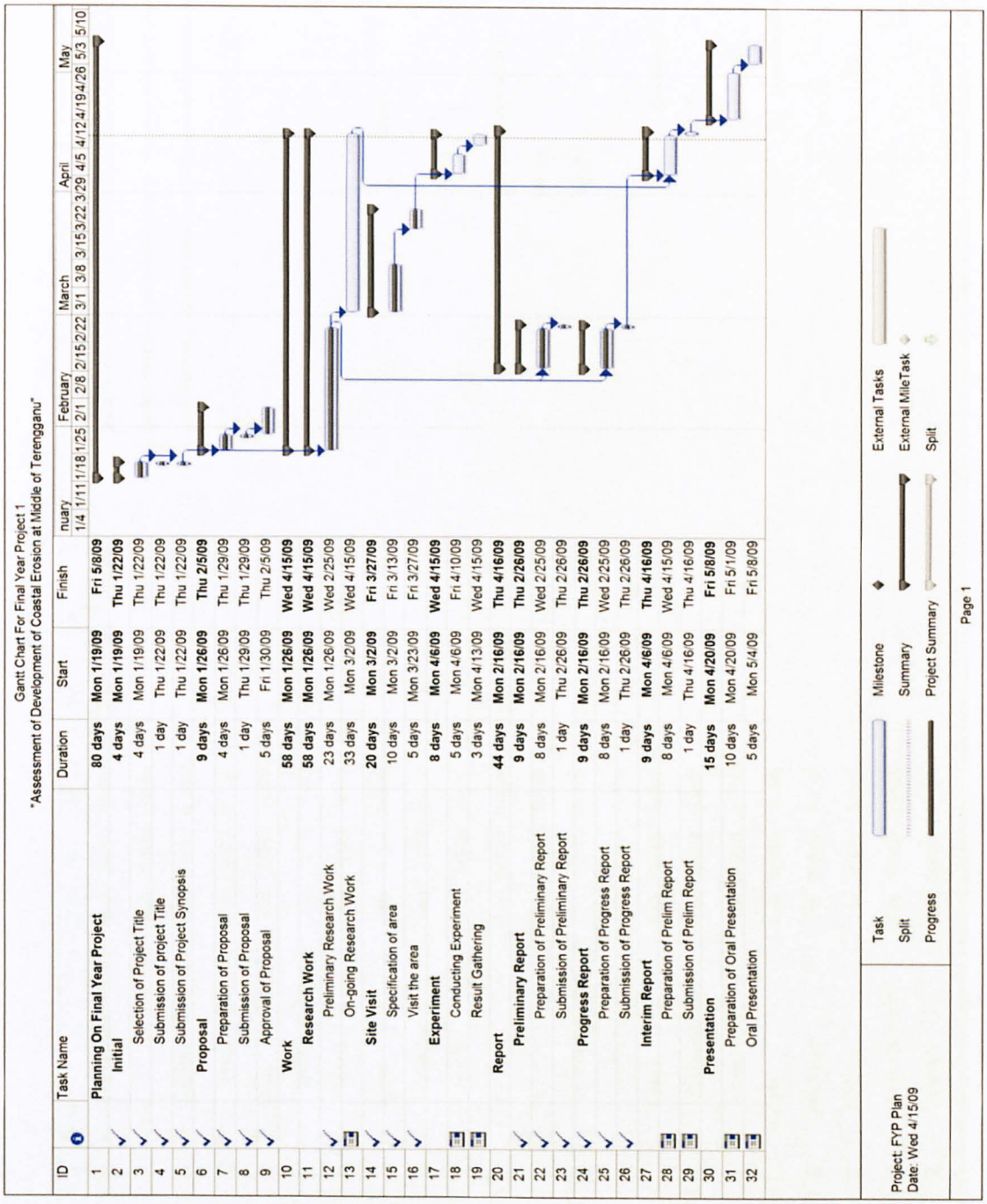

Figure 3.2: Gantt chart for First Semester

Gantt Chart For Final Year Project 1
"Assessment of Development of Coastal Erosion at Middle of Terengganu"

ID	Task Name	Duration	Start	Finish
1	**Planning on Final Year Project II**	**126 days**	**Thu 5/21/09**	**Fri 11/6/09**
2	**Work**	**121 days**	**Thu 5/21/09**	**Sat 10/31/09**
3	**Research Work**	**121 days**	**Thu 5/21/09**	**Sat 10/31/09**
4	On-going Research Work	121 days	Thu 5/21/09	Sat 10/31/09
5	**Site Visit**	**5 days**	**Tue 9/1/09**	**Mon 9/7/09**
6	Specification of area	4 days	Tue 9/1/09	Fri 9/4/09
7	Visit the area	1 day	Sat 9/5/09	Mon 9/7/09
8	**Experiment**	**9 days**	**Fri 9/11/09**	**Tue 9/22/09**
9	Conducting Experiment	6 days	Fri 9/11/09	Fri 9/18/09
10	Interpret Result	3 days	Sat 9/19/09	Tue 9/22/09
11	**Report**	**46 days**	**Wed 8/19/09**	**Fri 10/16/09**
12	**Progress Report**	**12 days**	**Wed 8/19/09**	**Thu 9/3/09**
13	Preparation of Progress Report	11 days	Wed 8/19/09	Wed 9/2/09
14	Submission of Progress Report	1 day	Thu 9/3/09	Thu 9/3/09
15	**Final Report**	**20 days**	**Wed 9/23/09**	**Fri 10/16/09**
16	Preparation of Final Report	14 days	Wed 9/23/09	Fri 10/9/09
17	Submission of Final Report	6 days	Sat 10/10/09	Fri 10/16/09
18	**Presentation**	**33 days**	**Mon 9/28/09**	**Fri 11/6/09**
19	Poster Preparation	5 days	Mon 9/28/09	Fri 10/2/09
20	Poster Exhibition	6 days	Sat 10/3/09	Fri 10/9/09
21	Preparation of Oral Presentation	6 days	Fri 10/23/09	Fri 10/30/09
22	Oral Presentation	6 days	Sat 10/31/09	Fri 11/6/09

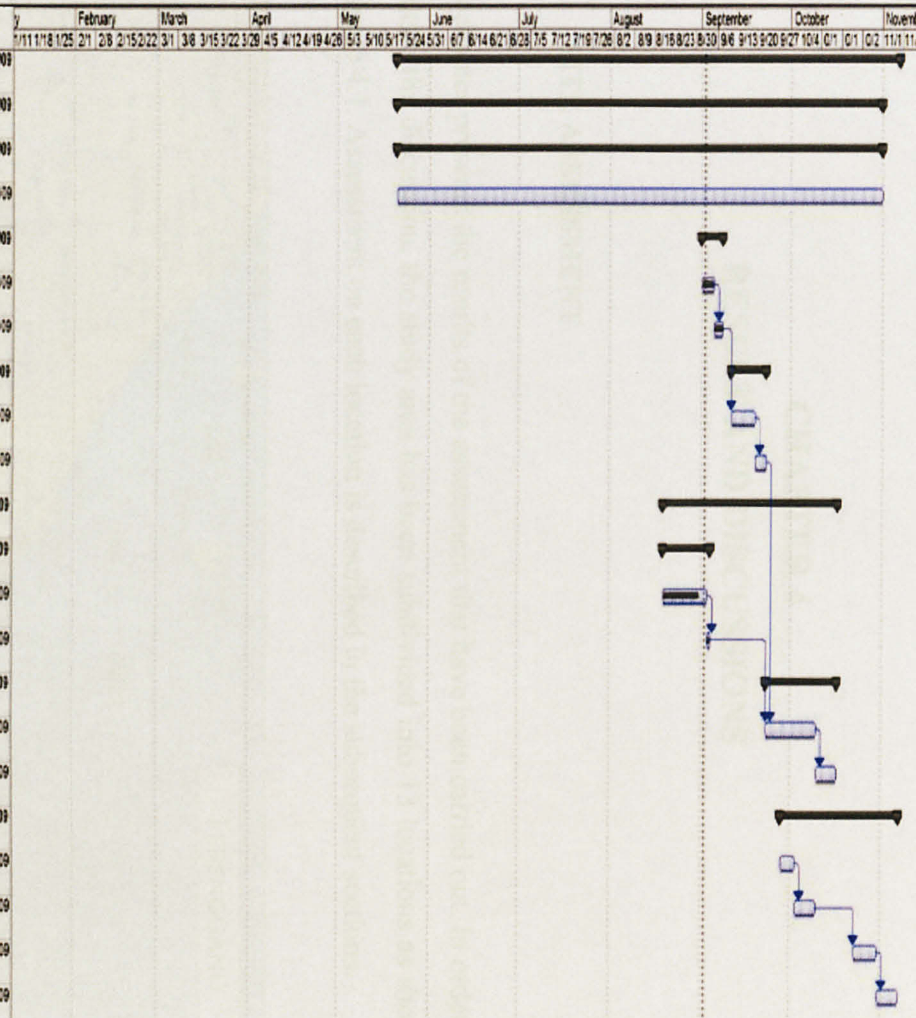

Figure 3.3: Gantt chart for Second Semester

CHAPTER 4
RESULT AND DISCUSSIONS

4.1 SITE ASSESSMENT

This chapter presents the results of the assessment that have been carried out. In order to facilitate the discussion, the study area has been subdivided into 13 locations as shown in Figure 4.1. Assessment on each location is described in the subsequent sections.

Figure 4.1: The location of erosion and samples taken

4.1.1 Batu Rakit Beach

The visit is held as follows details:

- Date/Day: 6th September 2009, Sunday
- Time: 1.30 PM
- Location: Batu Rakit
- Wind: Moderate
- Weather: Sunny
- Tide: Low tide
- Description: Well graded
- Length: 2.0 km
- Category: 3

Figure 4.2: Batu Rakit Beach

4.1.2 Tok Jembal Beach

The visit is held as follows details:

- Date/Day: 6th September 2009, Sunday
- Time: 1.00 PM
- Location: Kg Wakaf Tok Jembal
- Wind: Windy
- Weather: Sunny
- Tide: Low tide
- Description: Poorly graded
- Length: 1.0 km
- Category: 1

Figure 4.3: Tok Jembal Beach

4.1.3 Teluk Ketapang Beach

The visit is held as follows details:

- Date/Day: 26th March 2009, Thursday
- Time: 12.15 PM
- Location: Teluk Ketapang
- Wind: Moderate
- Weather: Sunny
- Tide: Decrease to low tide
- Description: Well graded
- Length: 5.0 km
- Category: 3

Figure 4.4: Teluk Ketapang Beach

Figure 4.5: Heavily under construction near Teluk Ketapang Airport

Figure 4.6: Revetment is under construction near Teluk Ketapang Airport

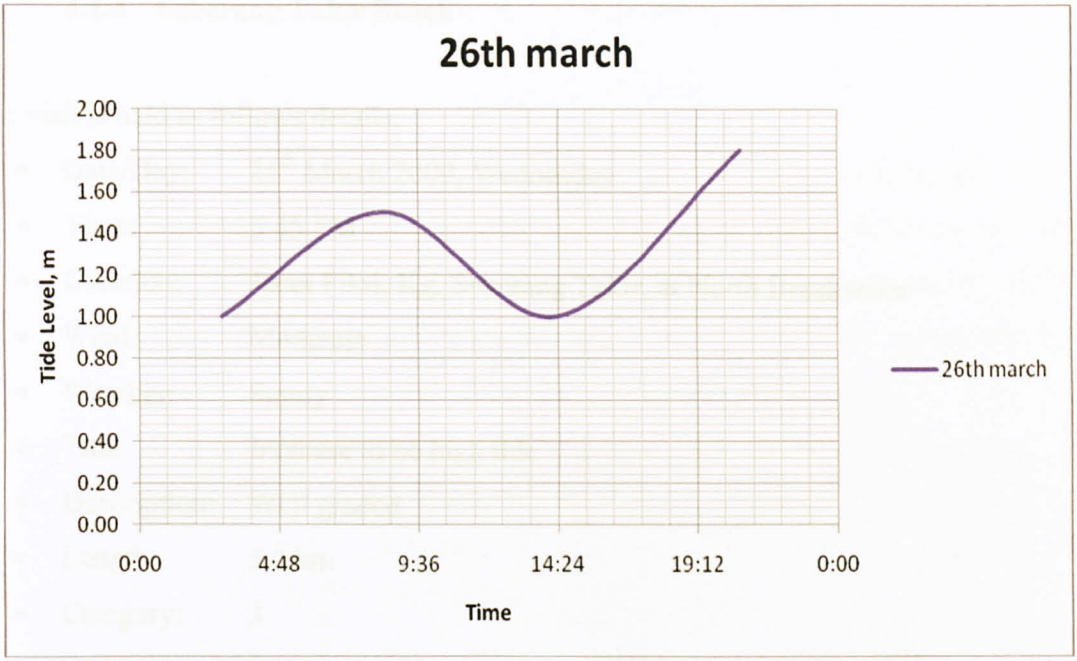

Figure 4.7: Tidal Chart for Teluk Ketapang on 26th March 2009

4.1.4 Seberang Takir Beach

The visit is held as follows details:

- Date/Day: 25th March 2009, Wednesday
- Time: 5.45 PM
- Location: Jalan Fikri, Kg. Seberang Takir, at North Breakwater
- Wind: Moderate
- Weather: Sunny
- Tide: Increase to be high tide
- Description: Well graded
- Length: 5.0 km
- Category: 3

During the site visit to this breakwater, this project is still on-going project. I have opportunity to meet the Project Manager, En Wan Mohd Napis Wan Mahmood to tell briefly about the project. According to him, this area between Seberang Takir and Batu Boruk, the coastal is categorized as Category 1 which is very critical. The erosion is caused by the northern monsoon but the southern wind stabilized back the beach sand. Thus the local authority is decided to construct the coastal erosion control to this area.

En Wan explained that this project has several objectives which are:

- For navigation
- To maintain the rivermouth condition
- To avoid flood at the area by constructing the training wall

Some coastal erosion control that been used to this project are:

- Breakwater

There are two breakwaters in this project which are North Breakwater and South Breakwater. The North Breakwater has length of 2345 m and the South Breakwater has length of 1115 m. this breakwater has the height of 6.75 m for the mean sea level. For the maximum high tide, these breakwaters are still more height than the maximum high tide. This breakwater used stones instead of using concrete-shaped boxes.

Figure 4.8: North Breakwater at Kuala Terengganu Rivermouth

- Beach nourishment

800 m of beach nourishment is in the planning located at the northern area while 5500 m at the southern area. According to En Wan, the 800 m of beach nourishment at northern area will not be built as the local authority (JPS) instructed not to do so. But, during the site visit to the area, some reclamation work is being done.

Figure 4.9: Beach nourishment that expected to be done at Northern area

Figure 4.10: Revetment at the area that expected to have beach nourishment

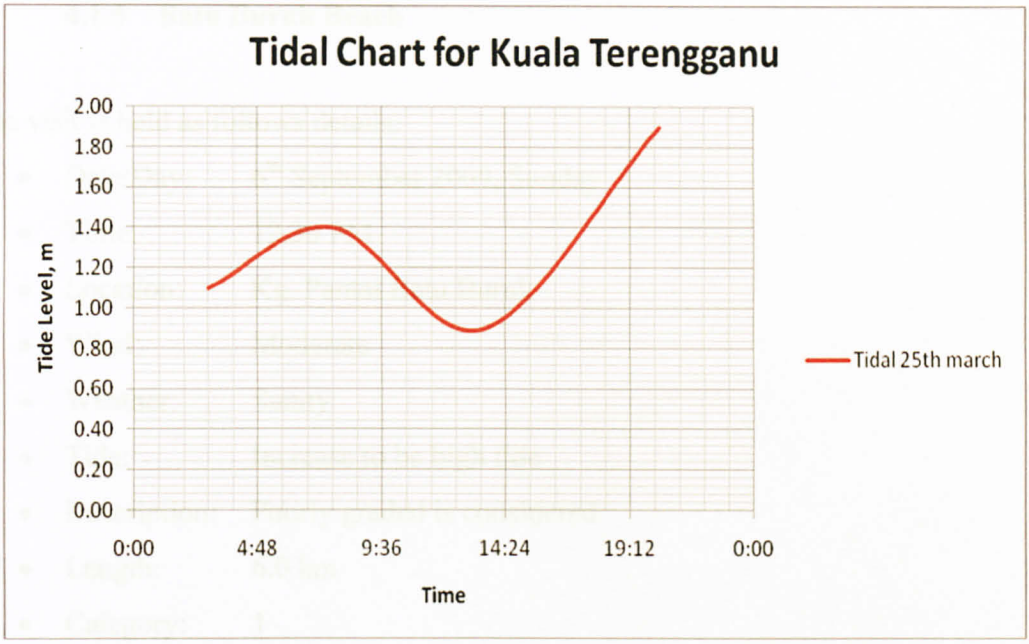

Figure 4.11: Tidal Chart for Kuala Terengganu on 25th March 2009

4.1.5 Batu Buruk Beach

The visit is held as follows details:

- Date/Day: 6th September 2009, Sunday
- Time: 12.30 PM
- Location: Kg. Pantai Batu Buruk
- Wind: Moderate
- Weather: Sunny
- Tide: Increase to be high tide
- Description: Poorly graded is considered
- Length: 6.0 km
- Category: 1

Figure 4.12: Beach condition at Batu Buruk Beach

4.1.6 Pandak Beach

The visit is held as follows details:

- Date/Day: 6th September 2009, Sunday
- Time: 12.20 PM
- Location: Near to Kg. Cenering
- Wind: No wind
- Weather: Sunny
- Tide: Low tide
- Description: Well graded
- Length: 2.0 km
- Category: 3

Figure 4.13: Beach condition at Pandak Beach

Figure 4.14: Another beach condition at Pandak Beach

4.1.7 Rusila Beach

The visit is held as follows details:

- Date/Day: 6th September 2009, Sunday
- Time: 12.00 PM
- Location: Kg. Rusila
- Wind: Windy
- Weather: Sunny
- Tide: Low tide
- Description: Well graded
- Length: 2.0 km
- Category: 1

Figure 4.15: Beach condition at Rusila Beach

From the result obtained, sand beach at Rusila is considered as well graded with the D_{50} is 0.32 mm to 0.7 mm. But from the site assessment with the aid of information from Drainage and Irrigation Department Kuala Terengganu, Rusila beach is considered as heavily having the erosion problem and it lays under category 1 which the drastic and comprehensive action and remediation should be taken to this beach. The length of beach which faces erosion problem is 2.0 km.

Figure 4.16: The concrete stairs is broken due to the erosion at Rusila Beach

4.1.8 Marang Beach

The visit is held as follows details:

- Date/Day: 25th March 2009, Wednesday
- Time: 11.15 AM
- Location: Kg. Seberang Marang
- Wind: Moderate
- Weather: Sunny
- Tide: Decrease to low tide
- Description: Well graded
- Length: 2.0 km
- Category: 3

This breakwater is also to protect the rivermouth condition whereby to maintain the navigation of fishermen. According to villagers, during the northern monsoon, the wave is higher than the breakwater. This breakwater used concrete-shape instead of using stones.

Figure 4.17: Concrete Breakwater at Marang

4.1.9 Rhu Muda Beach

The visit is held as follows details:

- Date/Day: 6th September 2009, Sunday
- Time: 11.40 AM
- Location: Kg. Rhu Muda
- Wind: Windy
- Weather: Sunny
- Tide: Low tide
- Description: Poorly graded
- Length: 2.0 km
- Category: 2

Figure 4.18: Beach condition at Rhu Muda

Figure 4.19: Another beach condition at Rhu Muda

4.1.10 Kerengga Beach

The visit is held as follows details:

- Date/Day: 6th September 2009, Sunday
- Time: 11.25 AM
- Location: Kg. Pulau Kerengga
- Wind: Moderate
- Weather: Sunny
- Tide: Low tide
- Description: Poorly graded
- Length: 2.0 km
- Category: 2

Figure 4.20: Beach condition at Kerengga

4.1.11 Merchang Beach

The visit is held as follows details:

- Date/Day: 6th September 2009, Sunday
- Time: 11.10 AM
- Location: Kg. Merchang
- Wind: Moderate
- Weather: Sunny
- Tide: Low tide
- Description: Poorly graded
- Length: 3.0 km
- Category: 2

Figure 4.21: Beach condition at Kg. Merchang

4.1.12 Kelulut Beach

The visit is held as follows details:

- Date/Day: 6th September 2009, Sunday
- Time: 10.40 AM
- Location: Kg. Pasir Putih
- Wind: Moderate
- Weather: Sunny
- Tide: Low tide
- Description: Well graded
- Length: 2.0 km
- Category: 2

Figure 4.22: Beach condition at Kg. Pasir Putih

4.1.13 Jambu Bongkok Beach

The visit is held as follows details:

- Date/Day: 6th September 2009, Sunday
- Time: 10.10 AM
- Location: Kg. Jambu Bongkok
- Wind: Moderate
- Weather: Sunny
- Tide: Low tide
- Description: Well graded
- Length: 2.0 km
- Category: 3

Figure 4.23: Beach condition at Kg. Jambu Bongkok

4.2 SIEVE ANALYSIS RESULTS

No	Location		D_{10}	D_{30}	D_{50}	D_{60}	C_u	C_k	Description
1	Batu Rakit Beach	Near beach	0.40	0.51	0.60	0.65	1.6250	1.0004	Well graded
		Far from beach	0.38	0.50	0.60	0.60	1.5789	1.0965	Well graded
		Far from beach	0.40	0.50	0.60	0.61	1.5250	1.0246	Well graded
2	Tok Jembal Beach	Near beach	0.19	0.37	0.32	0.38	2.0000	1.8961	Well graded
		Far from beach	0.24	0.34	0.44	0.51	2.1250	0.9444	Poorly graded
		Far from beach	0.26	0.33	0.40	0.46	1.7692	0.9105	Poorly graded
3	Teluk Ketapang Beach	Near beach	0.42	0.60	0.61	0.65	1.5476	1.3187	Well graded
4	Seberang Takir Beach	Near beach	0.45	0.60	0.69	0.70	1.5556	1.1429	Well graded
5	Batu Buruk Beach	Near beach	0.20	0.23	0.60	0.70	3.5000	0.3779	Poorly graded
		Far from beach	0.16	0.21	0.23	0.26	1.6250	1.0601	Well graded
		Far from beach	0.17	0.22	0.25	0.28	1.6471	1.0168	Well graded
6	Pandak Beach	Near beach	0.096	0.17	0.20	0.22	2.2917	1.3684	Well graded
		Far from beach	0.097	0.18	0.20	0.24	2.4742	1.3918	Well graded
		Far from beach	0.098	0.18	0.20	0.24	2.4490	1.3776	Well graded
7	Rusila Beach	Near beach	0.23	0.30	0.32	0.37	1.6087	1.0576	Well graded
		Far from beach	0.32	0.55	0.70	0.80	2.5000	1.1816	Well graded
8	Marang Beach	Near beach	0.42	0.60	0.62	0.65	1.5476	1.3187	Well graded

No	Location		D_{10}	D_{30}	D_{50}	D_{60}	C_u	C_k	Description
9	Rhu Muda Beach	Near beach	0.28	0.35	0.42	0.48	1.7143	0.9115	Poorly graded
		Far from beach	0.16	0.23	0.28	0.37	2.3125	0.8936	Poorly graded
		Far from beach	0.17	0.22	0.27	0.32	1.8824	0.8897	Poorly graded
10	Kerengga Beach	Near beach	0.31	0.37	0.46	0.48	1.5484	0.9200	Poorly graded
		Far from beach	0.37	0.50	0.64	0.70	1.8919	0.9653	Poorly graded
		Far from beach	0.27	0.50	0.62	0.70	2.5926	1.3228	Well graded
11	Merchang Beach	Near beach	0.22	0.33	0.32	0.58	2.7727	0.8115	Poorly graded
		Far from beach	0.30	0.40	0.44	0.45	1.6000	1.1111	Well graded
		Far from beach	0.30	0.37	0.40	0.42	1.5667	0.9709	Poorly graded
12	Kelulut Beach	Near beach	0.20	0.27	0.31	0.33	1.6500	1.1045	Well graded
		Far from beach	0.35	0.77	0.80	0.85	2.4286	1.9929	Well graded
		Far from beach	0.34	0.78	0.90	0.93	2.7353	1.9241	Well graded
13	Jambu Bongkok Beach	Near beach	0.28	0.42	0.52	0.55	1.9643	1.1455	Well graded
		Far from beach	0.40	0.50	0.60	0.61	1.5250	1.0246	Well graded
		Far from beach	0.39	0.48	0.57	0.62	1.5897	0.9529	Poorly graded

Table 4.2: Interpreting results obtained

CHAPTER 5
CONCLUSION & RECOMMENDATIONS

5.1 CONCLUSION

This research successfully assessed the current environment and coastal erosion status along the shoreline from Kampung Merabang Panjang, Batu Rakit until Kampung Jambu Bongkok, Marang. The assessment was based on the site visit and assessment to see and pictures captured the actual beach condition. The latest results can be compared with the previous results obtained in National Coastal Erosion Study (NCES, 1986).

Specifically this report included assessment on three major constructions for coastal erosion control either already completed or still undergoing. Two projects were completed which include at Seberang Takir, Kuala Terenganu and Kuala Marang, Marang. Both places are built with breakwater. Previously both places are considered as category 1 before the breakwater were built but based on the site assessment and experiment results obtained, it shows that both places are now in category 3. It can be concluded that the coastal erosion control built perform reasonably well. At Teluk Ketapang, the project is still ongoing with reclamation and revetment activities. Although the project is still ongoing, the assessment indicates and experiment results obtained, it shows that Teluk Ketapang is in Category 1 compared to previous category which is category 1. Again, this can be concluded that the coastal erosion control built shows the good performance.

From the findings obtained, this report would like to suggest to the authority to take action on the area that under category 1 which need the immediate recovery and control to prevent the shoreline become more severe. Not only that, other areas that under category 2 also need to be taken care. If no action taken, these areas will become more erosion and will be under category 1 in coming years.

5.2 RECOMMENDATIONS

For future research and work, it is recommended to have proper and standard format to assess the coastal erosion. There might be more other parameters should be included in the research. The assessment should not be only based on the site assessment and sieve analysis only, but there are more other factors that will contribute to erosion such as sedimentation transport, wind direction, wave and current. Therefore, further research should be more details so that the research is more reliable and quality.

Relationship with government and private agencies are also important to have actual and current situation in drifting salient factors that contribute to erosion. Also, with the aid of information from these agencies, the research can be further improved and better assessment can be achieved.

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APPENDICES

KUALA TERENGGANU, TERENGGANU DARUL IMAN

Lat 05 21 N Long 103 08 E

TIME ZONE -0800 TIMES AND HEIGHTS OF HIGH AND LOW WATERS 2009

JANUARY

	Time	m		Time	m		Time	m		Time	m
1 Th	1602	1.0	16 F	0023 0738 1138 1700	2.5 1.5 1.6 1.2	1 Su	0638 1224 1719 2358	1.2 1.7 1.4 2.0	16 M	0649 1438 1859 2129	0.9 1.9 1.8 1.8
2 F	0022 1626	2.5 1.1	17 Sa	0037 0759 1324 1723	2.3 1.3 1.7 1.5	2 M	0702 1349 1809 2353	1.1 1.8 1.6 1.9	17 T	0716 1632	0.9 2.0
3 Sa	0041 0835 1134 1650	2.4 1.5 1.6 1.3	18 Su	0036 0821 1538 1722	2.1 1.2 1.8 1.8	3 T	0733 1543	1.0 1.9	18 W	0750 1800	0.8 2.1
4 Su	0059 0828 1338 1704	2.3 1.4 1.6 1.5	19 M	0010 0839 2150	2.0 1.1 2.0	4 W	0811 1757	0.9 2.1	19 Th	0837 1845	0.8 2.2
5 M	0114 0848	2.1 1.3	20 T	0902 1927	1.0 2.2	5 Th	0900 1855	0.8 2.3	20 F	0938 1921	0.8 2.2
6 T	0110 0917 1851	2.0 1.1 2.1	21 W	0935 1941	1.0 2.3	6 F	0959 1940	0.7 2.5	21 Sa	1054 1954	0.8 2.3
7 W	0952 1913	1.0 2.3	22 Th	1021 2001	0.9 2.4	7 Sa	1105 2023	0.6 2.6	22 Su	1208 2028	0.7 2.3
8 Th	1034 1951	0.8 2.5	23 F	1119 2028	0.9 2.4	8 Su	1212 2103	0.5 2.7	23 M	0434 0521 1304 2059	1.3 1.3 0.7 2.3
9 F	1124 2034	0.7 2.7	24 Sa	1223 2101	0.8 2.5	9 M	1317 2141	0.5 2.7	24 T	0412 0630 1349 2125	1.3 1.4 0.7 2.3
10 Sa	1223 2120	0.6 2.8	25 Su	1319 2135	0.8 2.5	10 T ○	0438 0611 1414 2216	1.5 1.6 0.6 2.6	25 W ●	0411 0739 1428 2147	1.3 1.4 0.8 2.2
11 Su ○	1324 2205	0.5 2.9	26 M ●	1403 2207	0.7 2.5	11 W	0449 0748 1506 2244	1.5 1.6 0.7 2.5	26 Th	0415 0850 1504 2207	1.3 1.5 0.9 2.1
12 M	1422 2249	0.5 2.9	27 T	1438 2235	0.7 2.5	12 Th	0513 0939 1552 2304	1.4 1.6 0.9 2.3	27 F	0425 0947 1541 2223	1.2 1.6 1.0 2.0
13 T	1512 2328	0.6 2.8	28 W	1508 2258	0.8 2.4	13 F	0538 1051 1634 2316	1.2 1.7 1.1 2.1	28 Sa	0440 1039 1623 2236	1.1 1.7 1.1 1.9
14 W	1555	0.7	29 Th	0559 0807 1537 2318	1.5 1.6 0.9 2.4	14 Sa	0603 1157 1715 2322	1.1 1.8 1.4 2.0			
15 Th	0000 0728 0922 1631	2.7 1.6 1.6 1.0	30 F	0606 0958 1607 2335	1.5 1.6 1.0 2.3	15 Su	0626 1312 1800 2316	1.0 1.7 1.6 1.9			
			31 Sa	0620 1117 1640 2348	1.4 1.6 1.2 2.1						

FEBRUARY

	Time	m		Time	m		Time	m		Time	m
1 Su	0638 1224 1719 2358	1.2 1.7 1.4 2.0	16 M	0649 1438 1859 2129	0.9 1.9 1.8 1.8	1 Su	0459 1131 1708 2243	1.0 1.9 1.3 1.8	16 M	0507 1242 1831 2055	0.7 2.0 1.6 1.6
2 M	0702 1349 1809 2353	1.1 1.8 1.6 1.9	17 T	0716 1632	0.9 2.0	2 M	0523 1228 1808 2242	0.8 1.9 1.5 1.7	17 T	0530 1342	0.6 2.0
3 T	0733 1543	1.0 1.9	18 W	0750 1800	0.8 2.1	3 T	0550 1339 1942 2123	0.8 2.0 1.6 1.7	18 W	0555 1449	0.7 2.0
4 W	0811 1757	0.9 2.1	19 Th	0837 1845	0.8 2.2	4 W	0622 1508	0.7 2.1	19 Th	0623 1615	0.7 2.0
5 Th	0900 1855	0.8 2.3	20 F	0938 1921	0.8 2.2	5 Th	0704 1659	0.6 2.2	20 F	0707 1733	0.7 2.0
6 F	0959 1940	0.7 2.5	21 Sa	1054 1954	0.8 2.3	6 F	0808 1818	0.6 2.3	21 Sa	0819 1823	0.8 2.1
7 Sa	1105 2023	0.6 2.6	22 Su	1208 2028	0.7 2.3	7 Sa	0927 1907	0.6 2.4	22 Su	1000 1902	0.8 2.1
8 Su	1212 2103	0.5 2.7	23 M	0434 0521 1304 2059	1.3 1.3 0.7 2.3	8 Su	1046 1948	0.6 2.4	23 M	0328 0513 1133 1935	1.1 1.1 0.9 2.1
9 M	1317 2141	0.5 2.7	24 T	0412 0630 1349 2125	1.3 1.4 0.7 2.3	9 M	1201 2024	0.6 2.4	24 T	0302 0552 1238 2002	1.1 1.2 0.9 2.0
10 T ○	0438 0611 1414 2216	1.5 1.6 0.6 2.6	25 W ●	0411 0739 1428 2147	1.3 1.4 0.8 2.2	10 T	0312 0614 1308 2055	1.3 1.4 0.7 2.3	25 W	0253 0743 1333 2023	1.1 1.4 0.9 1.9
11 W	0449 0748 1506 2244	1.5 1.6 0.7 2.5	26 Th	0415 0850 1504 2207	1.3 1.5 0.9 2.1	11 W	0323 0801 1408 2122	1.2 1.5 0.8 2.2	26 Th ●	0251 0826 1423 2042	1.0 1.5 1.0 1.8
12 Th	0513 0939 1552 2304	1.4 1.6 0.9 2.3	27 F	0425 0947 1541 2223	1.2 1.6 1.0 2.0	12 Th ○	0341 0907 1504 2141	1.1 1.7 0.9 2.0	27 F	0256 0909 1511 2059	0.9 1.7 1.0 1.7
13 F	0538 1051 1634 2316	1.2 1.7 1.1 2.1	28 Sa	0440 1039 1623 2236	1.1 1.7 1.1 1.9	13 F	0403 1002 1555 2156	0.9 1.8 1.1 1.9	28 Sa	0310 0954 1601 2112	0.8 1.9 1.1 1.6
14 Sa	0603 1157 1715 2322	1.1 1.8 1.4 2.0				14 Sa	0423 1055 1644 2204	0.8 1.9 1.3 1.7	29 Su	0331 1040 1653 2120	0.7 2.0 1.2 1.6
15 Su	0626 1312 1800 2316	1.0 1.7 1.6 1.9				15 Su	0445 1148 1734 2205	0.7 2.0 1.4 1.7	30 M	0355 1129 1752 2123	0.6 2.1 1.4 1.5
									31 T	0422 1223 1907 2038	0.5 2.2 1.5 1.5

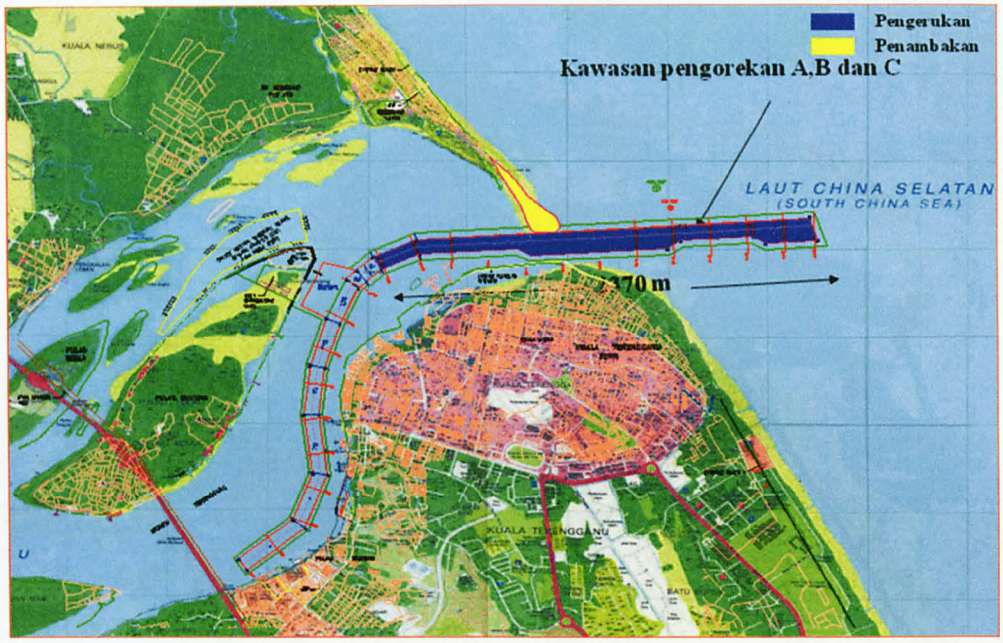
MARCH

	Time	m		Time	m		Time	m		Time	m
1 Su	0459 1131 1708 2243	1.0 1.9 1.3 1.8	16 M	0507 1242 1831 2055	0.7 2.0 1.6 1.6	1 W	0452 1327	0.5 2.2	16 Th	0441 1353	0.5 2.1
2 M	0523 1228 1808 2242	0.8 1.9 1.5 1.7	17 T	0530 1342	0.6 2.0	2 Th	0524 1440	0.5 2.2	17 F	0506 1446	0.6 2.1
3 T	0550 1339 1942 2123	0.8 2.0 1.6 1.7	18 W	0555 1449	0.7 2.0	3 F	0609 1602	0.5 2.2	18 Sa	0532 1543	0.7 2.0
4 W	0622 1508	0.7 2.1	19 Th	0623 1615	0.7 2.0	4 Sa	0715 1720	0.6 2.2	19 Su	0603 1642	0.8 2.0
5 Th	0704 1659	0.6 2.2	20 F	0707 1733	0.7 2.0	5 Su	0849 1814	0.7 2.2	20 M	0253 0628 0723 1732	0.9 1.0 0.9 1.9
6 F	0808 1818	0.6 2.3	21 Sa	0819 1823	0.8 2.1	6 M	0237 0408 1029 1854	1.1 1.1 0.8 2.1	21 T	0205 0657 1030 1806	0.9 1.1 1.1 1.8
7 Sa	0927 1907	0.6 2.4	22 Su	1000 1902	0.8 2.1	7 T	0202 0638 1155 1927	1.0 1.3 0.9 2.0	22 W	0137 0723 1221 1830	0.9 1.3 1.1 1.7
8 Su	1046 1948	0.6 2.4	23 M	0328 0513 1133 1935	1.1 1.1 0.9 2.1	8 W	0208 0741 1312 1953	0.9 1.5 1.0 1.9	23 Th	0126 0753 1334 1853	0.8 1.6 1.2 1.6
9 M	1201 2024	0.6 2.4	24 T	0302 0552 1238 2002	1.1 1.2 0.9 2.0	9 Th	0221 0832 1421 2013	0.8 1.8 1.1 1.7	24 F	0129 0826 1435 1911	0.7 1.8 1.2 1.5
10 T	0312 0614 1308 2055	1.3 1.4 0.7 2.3	25 W	0253 0743 1333 2023	1.1 1.4 0.9 1.9	10 F ○	0236 0919 1522 2026	0.7 1.9 1.2 1.6	25 Sa ●	0144 0906 1529 1927	0.6 2.0 1.2 1.4
11 W	0323 0801 1408 2122	1.2 1.5 0.8 2.2	26 Th ●	0251 0826 1423 2042	1.0 1.5 1.0 1.8	11 Sa	0255 1003 1616 2030	0.6 2.1 1.3 1.5	26 Su	0207 0949 1623 1942	0.4 2.2 1.2 1.4
12 Th ○	0341 0907 1504 2141	1.1 1.7 0.9 2.0	27 F	0256 0909 1511 2059	0.9 1.7 1.0 1.7	12 Su	0315 1046 1708 2028	0.5 2.2 1.4 1.4	27 M	0236 1036 1723 1954	0.3 2.3 1.3 1.4
13 F	0403 1002 1555 2156	0.9 1.8 1.1 1.9	28 Sa	0310 0954 1601 2112	0.8 1.9 1.1 1.6	13 M	0336 1129 1809 1929	0.5 2.2 1.4 1.4	28 T	0307 1126	0.3 2.4
14 Sa	0423 1055 1644 2204	0.8 1.9 1.3 1.7	29 Su	0331 1040 1653 2120	0.7 2.0 1.2 1.6	14 T	0355 1214	0.5 2.2	29 W	0340 1220	0.3 2.4
15 Su	0445 1148 1734 2205	0.7 2.0 1.4 1.7	30 M	0355 1129 1752 2123	0.6 2.1 1.4 1.5	15 W	0418 1301	0.5 2.2	30 Th	0415 1318	0.3 2.4
			31 T	0422 1223 1907 2038	0.5 2.2 1.5 1.5						

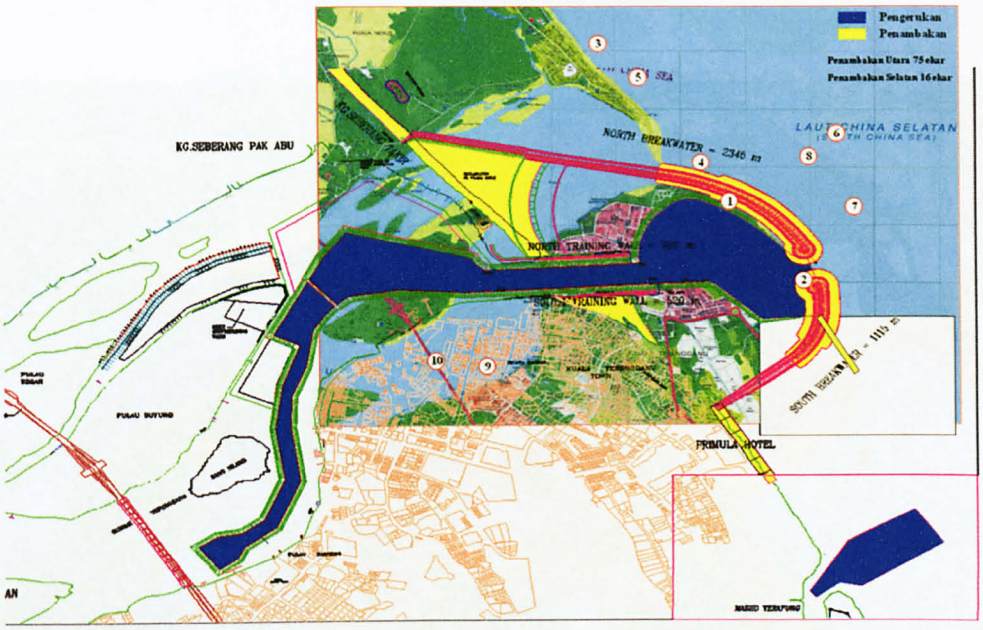
APRIL

	Time	m		Time	m
1 W	0452 1327	0.5 2.2	16 Th	0441 1353	0.5 2.1
2 Th	0524 1440	0.5 2.2	17 F	0506 1446	0.6 2.1
3 F	0609 1602	0.5 2.2	18 Sa	0532 1543	0.7 2.0
4 Sa	0715 1720	0.6 2.2	19 Su	0603 1642	0.8 2.0
5 Su	0849 1814	0.7 2.2	20 M	0253 0628 0723 1732	0.9 1.0 0.9 1.9
6 M	0237 0408 1029 1854	1.1 1.1 0.8 2.1	21 T	0205 0657 1030 1806	0.9 1.1 1.1 1.8
7 T	0202 0638 1155 1927	1.0 1.3 0.9 2.0	22 W	0137 0723 1221 1830	0.9 1.3 1.1 1.7
8 W	0208 0741 1312 1953	0.9 1.5 1.0 1.9	23 Th	0126 0753 1334 1853	0.8 1.6 1.2 1.6
9 Th	0221 0832 1421 2013	0.8 1.8 1.1 1.7	24 F	0129 0826 1435 1911	0.7 1.8 1.2 1.5
10 F ○	0236 0919 1522 2026	0.7 1.9 1.2 1.6	25 Sa ●	0144 0906 1529 1927	0.6 2.0 1.2 1.4
11 Sa	0255 1003 1616 2030	0.6 2.1 1.3 1.5	26 Su	0207 0949 1623 1942	0.4 2.2 1.2 1.4
12 Su	0315 1046 1708 2028	0.5 2.2 1.4 1.4	27 M	0236 1036 1723 1954	0.3 2.3 1.3 1.4
13 M	0336 1129 1809 1929	0.5 2.2 1.4 1.4	28 T	0307 1126	0.3 2.4
14 T	0355 1214	0.5 2.2	29 W	0340 1220	0.3 2.4
15 W	0418 1301	0.5 2.2	30 Th	0415 1318	0.3 2.4

Times and Heights of High and Low Waters



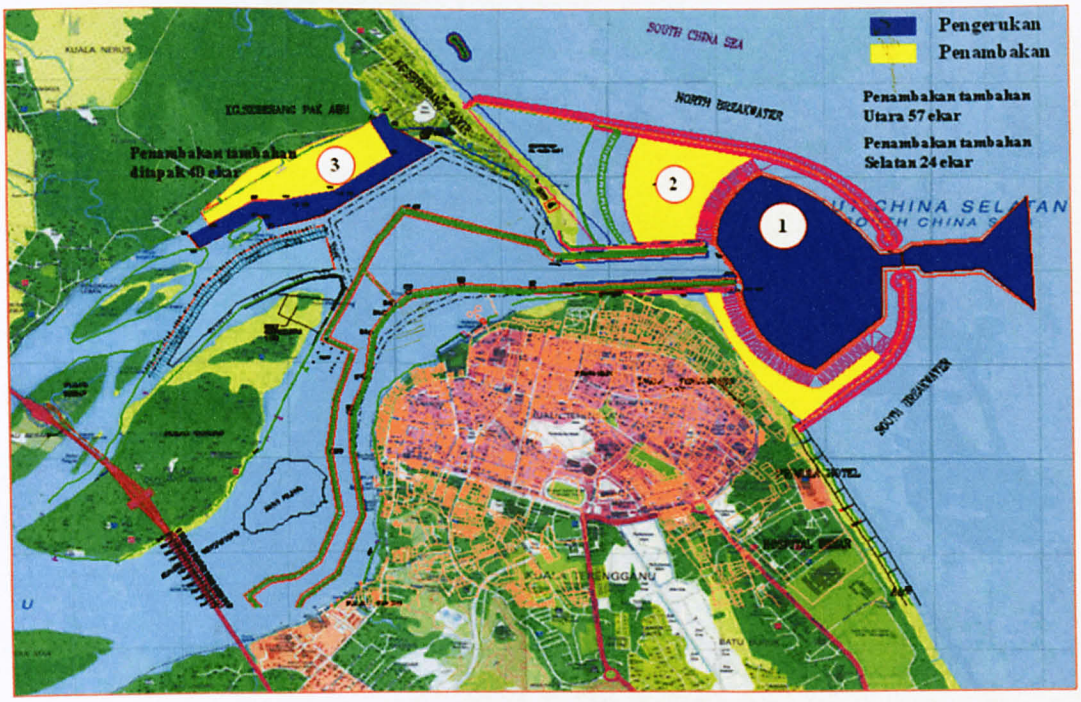
Area of Project Phase 1 at Kuala Terengganu Rivermouth, *source: Inai Kiara Sdn Bhd*



Area of Project Phase 2 at Kuala Terengganu Rivermouth *source: Inai Kiara Sdn Bhd*

Area of Project for Monsoon Cup 2005 at Kuala Terengganu Rivermouth

source: Inai Kiara Sdn Bhd



Area of Project Phase 2 Package 1 at Kuala Terengganu Rivermouth

source: Inai Kiara Sdn Bhd